Citation:

Nettleton JA, Steffen LM, Loehr LR, Rosamond WD, Folsom AR. Incident heart failure is associated with lower whole-grain intake and greater high-fat dairy and egg intake in the Atherosclerosis Risk in Communities (ARIC) Study. *J Am Diet Assoc*. 2008;108:1881-1887.

PubMed ID: 18954578

Study Design:

prospective cohort study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

The primary aim of the study was to describe the relationship between consumption of seven food categories (whole grains, fruits/vegetables, fish, nuts, high-fat dairy, eggs, red meat) and risk of incident heart failure (HF) in African-American and White adults participating in the Atherosclerosis Risk in Communities (ARIC) longitudinal cohort study.

The authors hypothesized that consumption of foods rich in antioxidants, fiber and polyunsaturated fatty acids would be inversely associated with risk of incident HF. In contrast, consumption of foods high in saturated fat and cholesterol would be positively associated with incident HF.

Inclusion Criteria:

- African-American and White adult men and women
- 45-64 years of age

Exclusion Criteria:

for currrent analysis:

- Racial groups with limited representation (n-48)
- African Americans from the Minnesota and Maryland field centers due to small numbers (n-=55)
- Subjects with insufficient dietary data or reported extreme energy intakes (<600 kcal or >4200 kcal per day for men or <500 kcal or >3600 kcal per day for women) (n=364)
- Subjects with prevalent HF at baseline (n=751). Prevalent HF was defined as current use of medications for HF or evidence of stage 3 HF at the baseline exam.

Description of Study Protocol:

Recruitment

- Not described.
- Four field centers were utilized in this study: Forsyth County, North Carolina; Jackson, MS; northwest Minneapolis suburbs, Minnesota; Washington county, Maryland.

Design

- prospective cohort study

Blinding used (if applicable)

Intervention (if applicable)

Statistical Analysis

- Baseline characteristics of the sample were determined using analysis of variance stratified by incident HF status.
- Hazard ratios (relative risks; RR) for incident HF according to dietary intake were determined using cox proportional hazards regression.
- Models used to evaluate the relationship between incident HF and dietary intake: Model 1 adjusted for energy intake; Model 2 adjusted for energy intake plus demographic characteristics, lifestyle factors and baseline history of disease; Model 3 (food group analyses) mutually adjusted for dietary intake factors.
- Model 2 also included a cross product term to evaluate whether the relationship between dietary intake and incident HF differed due to baseline body mass index, prevalent CVD, diabetes and hypertension.
- Statistical analyses done with SAS version 9.1.

Data Collection Summary:

Timing of Measurements

Baseline exam conducted in 1987-1989; follow-up exams conducted in 1990-1992 (Exam 2); 1993-1995 (Exam 3); and 1996-1998 (Exam 4).

Dependent Variables

- Incident HF: cases were identified by death certificates and local hospital discharge lists. Incident HF defined as initial hospitalization for HF or death where cause of death was HF. During 13.3 years follow-up, 1140 cases of incident HF were identified (639 men, 501 women; 360 African American, 780 White).

Independent Variables

- Dietary intake of seven food categories (whole grains, fruits/vegetables, fish, nuts, high-fat dairy, eggs, red meat):
    - Baseline (1987-1989) and Exam 3 (1993-1995) time points participants completed an

interviewer-administered semi-quantitative food frequency questionnaire (FFQ) (66 items; the FFQ was a modification of the validated Willett FFQ
- The Harvard Nutrient Database was used to determine nutrient intakes derived from the modified FFQ.

Control Variables

Description of Actual Data Sample:

Initial N: 15,792 (8,710 females, 7,082 males)

Attrition (final N): 14,153

Age: 45-64 years

Ethnicity: African-American and White

Other relevant demographics:

Anthropometrics: not given

Location:

- Four field centers: Forsyth County, North Carolina; Jackson, MS; northwest Minneapolis suburbs, Minnesota; Washington County, Maryland

Summary of Results:

Key Findings

- Greater intake of eggs and high fat dairy foods was associated with greater risk of incident HF
- Greater intake of whole grain foods was associated with lower risk of incident HF
- Associations were independent of demographic characteristics, lifestyle factors, prevalent CVD, diabetes or hypertension, and other food groups

Relative risks for heart failure according to food group intakes (servings/day)

Variables	Relative Risk (95% confidence interval)a
Whole Grains	
Model 1	0.85 (0.80, 0.90)*
Model 2	0.93 (0.87, 0.99)*

Fruits & Vegetables	1.01 (0.98. 1.04)
Model 1	1.02 (0.99, 1.05)
Model 2	
High-fat Dairy	1.14 (1.06, 1.22)*
Model 1	1.08 (1.01, 1.16)*
Model 2	
Eggs	1.56 (1.40, 1.73)*
Model 1	1.23 (1.08, 1.41)*
Model 2	
Red meat/proc meat	1.27 (1.18, 1.37)*
Model 1	1.07 (0.97, 1.17)
Model 2	
Fish	0.99 (0.82, 1.19)
Model 1	0.99 (0.81, 1.22)
Model 2	
Nuts	0.96 (0.85, 1.09)
Model 1	1.09 (0.97, 1.23)
Model 2	

*P<0.05

[a]Values are relative risks (95% confidence interval) representing expected change in risk of heart failure per 1-serving/d difference in food group consumption

Other Findings

- Incident HF developed in participants that were more frequently African-American, male, less educated, less physically active, current smokers, and less frequently current drinkers. Baseline body mass index and waist circumference was also greater in these participants.

Author Conclusion:

In this biracial adult cohort, increased intake of eggs or high fat dairy foods and decreased intake of whole grains was associated with increased risk of incident HF. Individuals at risk for HF should be advised to increase their consumption of whole grains and reduce their consumption of eggs and high fat dairy foods.

Reviewer Comments:

Study limitations include the following:

- *Outpatient cases of HF are not included*
- *Brevity of the FFQ instrument*
- *Potential measurement error associated with estimating whole grain intake*
- *Potential for residual confounding*
- *Data represent associations only not causality*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???

3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	No
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	No
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	No
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A

5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes

8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	Yes
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes